

CURRICULUM FOR YELLOWJACKETS—OUTLINE

TIME REQUIRED: 4 hours

NUMBER OF SESSIONS: One per year

SUGGESTED CLASS SIZE: Up to 20 participants

Objectives

1. To improve basic knowledge of stinging insects, focusing on yellowjacket identification, biology, and integrated pest management (IPM)
2. To practice yellowjacket monitoring techniques and data recording, evaluate management alternatives, and handle management tools and equipment

Lecture and Discussion

A. Introduction to the Hymenoptera, page 3



Ask class to define *insect*. Review characteristics of Hymenoptera, and stinging Hymenoptera such as ants, bees and wasps.

B. Identification of Social Wasps, pages 3–6

Review identification and classification of yellowjackets and other wasps in the family Vespidae. Explain how to keep from getting stung. Discuss yellowjacket characteristics. Distinguish between stinging bee-like Hymenoptera and syrphid flies.

C. Life Cycle, pages 6–7

Summarize yellowjacket life cycle.

D. Food Preferences, page 8

Review food preferences of the different stages through the seasons.

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School IPM Curriculum—Yellowjackets

E. IPM Program for Yellowjackets, pages 9–10

- ▶ Emphasize an IPM program based on sanitation and monitoring
- ▶ Sanitation Advice
- ▶ Trapping Tips
- ▶ Treatment Tips
- ▶ Review **Appendix 2**, *Controlling Yellowjackets Around Your Home*, **Appendix 3**, *Safe Use of Pesticides*, and **Appendix 4**, *Developing a Yellowjacket Trapping Program*.
- ▶ **Exercise: Monitoring Yellowjacket Populations, pages 10–11.**
The trainer places yellowjacket traps at various locations before starting exercise. Class discusses factors that may attract yellowjackets to specific areas. Class fills out the *Yellowjacket Monitoring Form*, page 11, to learn how to monitor yellowjackets.

References

Mussen, E. 2001. *Yellowjackets and Other Social Wasps*. UC IPM Pest Management Guidelines. UC DANR. (Pub. 7450). Oakland, Calif. 6 pp. <http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnyellowjackets.pdf>

Materials

Books

- ☐ See References

Equipment

- ☐ Hand lenses
- ☐ Dissecting microscopes

Suggested Displays

Traps

- ☐ Ten Sterling Brand Yellowjacket Traps with heptyl butyrate lures
- ☐ Different types of yellowjacket traps (although don't overdo it!)

Baits

- ☐ Liquid soap
- ☐ Lunchmeat such as turkey

Insect nests

- ☐ Yellowjacket nests and, if available, nests of other Hymenoptera

Pesticides used as toxicants

- ☐ Mint oil
- ☐ Tetramethrin and other pyrethroids
- ☐ Other insecticides for yellowjackets

Preserved insect specimens

- ☐ Two to three yellowjacket species, honey bee, bumble bee, syrphid fly, and winged ant (number with separate key available). May be available from local cooperative extension office.

CURRICULUM FOR YELLOWJACKETS—LESSON PLAN

A. Introduction to the Hymenoptera

Ask class to define insect

Instructor facilitates discussion about insect features such as six legs, three body parts, winged or wingless, antennae, and various types of mouthparts.

Characteristics of Hymenoptera

Hymenoptera, the insect order that includes ants, bees and wasps, is one of the most diverse groups of animals. Hymenoptera are valuable to both people and the environment. Bees, especially, are well known for pollinating agricultural crops and other plants. The relatively few kinds of wasp that sting when their nests are disturbed are also predaceous on plant-feeding insects. Perhaps most beneficial of all are the myriad natural enemies of insects found among the non-social wasps.

Members of the Order Hymenoptera are characterized by two pairs of membranous wings, clubbed antennae, and chewing mouthparts. Many species possess a constricted waist between their thorax and abdomen.

Figure 1. Two members of the hymenopteran family Vespidae. There are more than one hundred vespid species in California.

Yellowjacket



Photo © 2001 Bishop Museum, Honolulu, Hawaii. Used with permission.

Paper Wasp



Photo © 2001 I. Lindsey, www.kaweahoaks.com. Used with permission.

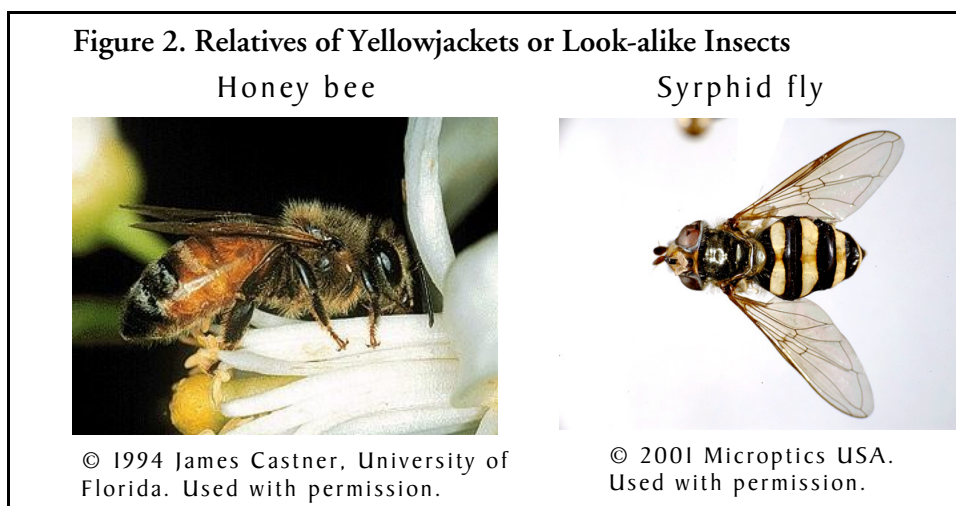
B. Identification of Social Wasps

Family Vespidae—Yellowjacket is a name for several species of social wasps that are all in the family Vespidae (Figure 1). Yellowjackets are sometimes called “meat bees,” although they aren’t bees at all.

School IPM Curriculum—Yellowjackets

Paper wasps are also vespids, but they generally stay away from people and, unlike yellowjackets, are not aggressive. There are more than one hundred species in this family in California alone, but only 15 species live in colonies (large nests), and are considered social. Yellowjackets are aggressive and predatory, and most are yellow and black in color. Yellowjackets are smaller than bumble bees and larger than honey bees or syrphid flies (Figure 2, Table 1).

A typical yellowjacket worker is about ½-inch long, short and blocky, with alternating black and yellow bands on the abdomen, while the queen is larger, about ¾-inch long. (The different black and yellow patterns on the abdomen help distinguish various species.) Syrphid or hover flies are about ½ inch long and don't sting. Most are beneficial—you can find their sluglike larvae on leaves, feeding on aphids.



Yellowjacket workers are sometimes confused with honey bees, especially when flying in and out of their nests. Honey bees, in contrast to yellowjackets, are covered with dense tannish-brown hair on their bodies and have flattened hairy hind legs for carrying pollen. Some yellowjackets have yellow facial markings. Yellowjackets have a lance-like stinger without barbs and can sting repeatedly, whereas honey bees have a barbed stinger and sting only once. Yellowjacket mouthparts are well developed for capturing and chewing insects. Yellowjackets also suck nectar and fruit juices with their long tongues.







Yellowjacket nests are built in shrubs, tree canopies or tree holes, or inside protected places such as attics, hollow walls or flooring, in sheds, under porches and eaves of houses, in soil cavities or in mouse burrows. Nests are made from wood fiber chewed into a paper-like pulp.

Paper wasps build their umbrella-like nests in protected areas such as under eaves or under tree branches. You can see the open cells from below, and sometimes the pale grublike larvae inside.

See **Appendix 1** for more information on yellowjackets and paper wasps, which is the reprinted UC IPM Pest Note, Publication 7450, *Yellowjackets and other social wasps*. Figure 2 shows the growth of a yellowjacket nest from spring to early fall, and Figure 3 is a drawing of a paper wasp nest.

School IPM Curriculum—Yellowjackets

Table 1. Important Stinging Hymenoptera

Pest (Family)	Description	Nest	Biting or Stinging Ability
honey bee (Apidae) 	$\frac{2}{3}$ in., yellow and black or brown, body covered with featherlike hairs	Made of wax cells, found in wall voids or under slab foundations	Yes
bumble bee (Apidae) 	1 in., black and yellow body densely covered with hair	Made of wax cells, below ground, under slabs, in wall voids	Yes
hornets and yellowjackets (Vespidae) 	$\frac{3}{4}$ in., black with yellow or white markings, not covered in hair	Made of papery material. Nests either aerial or below ground or both. Nests large and globular	Yes
mud daubers (Sphecidae) 	$\frac{3}{4}$ –1 in., black and yellow, or metallic blue, or shiny black	Made of clay or mud. Usually along eaves or in garages	Rarely sting
fire ants (Formicidae) 	$\frac{1}{16}$ – $\frac{1}{4}$ in., yellowish to dark red with stinger on end of abdomen	Mounds 3–36 in. high with surrounding vegetation undisturbed	Yes
velvet ant (Mutillidae) 	$\frac{1}{2}$ –1 in., wingless and ant-like, covered with hair, bright red, orange, yellow, or white	Solitary on ground	Sting only when handled or trapped
Adapted from P.G. Koehler & F.M. Oi. 2002. Stinging or Venomous Insects and Related Pests, ENY-215. Entomology & Nematology Dept., Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. All photos © 1994 James Castner. Used with permission.			

These don't sting! **Look-alike flies**—In addition to syrphid flies mentioned above, flies in other families resemble wasps. Two of these, both beneficial, are the Asilidae (robber flies) and Bombyliidae (bee flies).

School IPM Curriculum—Yellowjackets

How to keep from getting stung by yellowjackets

- Don't go barefoot.
- Don't swat a wasp with your hands.
- Keep lids on soft drinks and check food before you put it in your mouth.
- Avoid applying scented products, which often attract yellowjackets.
- Avoid wearing brightly colored clothes.

What if you do get stung?

Yellowjackets rarely sting if left alone. If you're stung, apply ice to the area to reduce the pain and swelling. Applying a baking soda–water paste may reduce itchiness. Unlike honey bees, yellowjackets rarely leave a stinger embedded in the skin. If you show signs of an allergic reaction to the sting such as difficulty breathing or dizziness, contact your physician immediately.

Why don't male yellowjackets sting?

Stingers are actually modified ovipositors (egg-laying tubes). Only females have ovipositors, so all male Hymenoptera therefore lack stingers. Unlike the workers—infertile females who forage for food, rear the young, and defend the nest—yellowjacket males don't need stingers. Their *raison d'être* is to mate with the queen—and only a few males in each nest ever succeed in doing this.

C. Life Cycle

Winter through early spring. Yellowjackets are social wasps that live in colonies containing female workers, queens, and males. Colonies are established annually by an inseminated (fertilized) queen. Fertilized queens overwinter in protected places such as hollow logs, stumps, under bark, in leaf litter, in soil cavities and human-made structures. Queens emerge during the warm days of late April or early May, select a nest site and build a small paper nest in which eggs are laid (Figure 3).

Spring through early summer. After eggs hatch from the 30 to 50 brood cells, the queen actively forages for prey and feeds the young larvae chewed-up insects and spiders for about 18 to 20 days. The larvae pupate, emerging as workers—small, infertile females—by mid-June in most parts of coastal California. (In inland California, workers begin foraging around May.) The first adult workers assume the tasks of nest expansion, foraging for food, care of the queen and larvae, and colony defense. From this time until her death in the autumn, the queen remains inside the nest laying eggs.

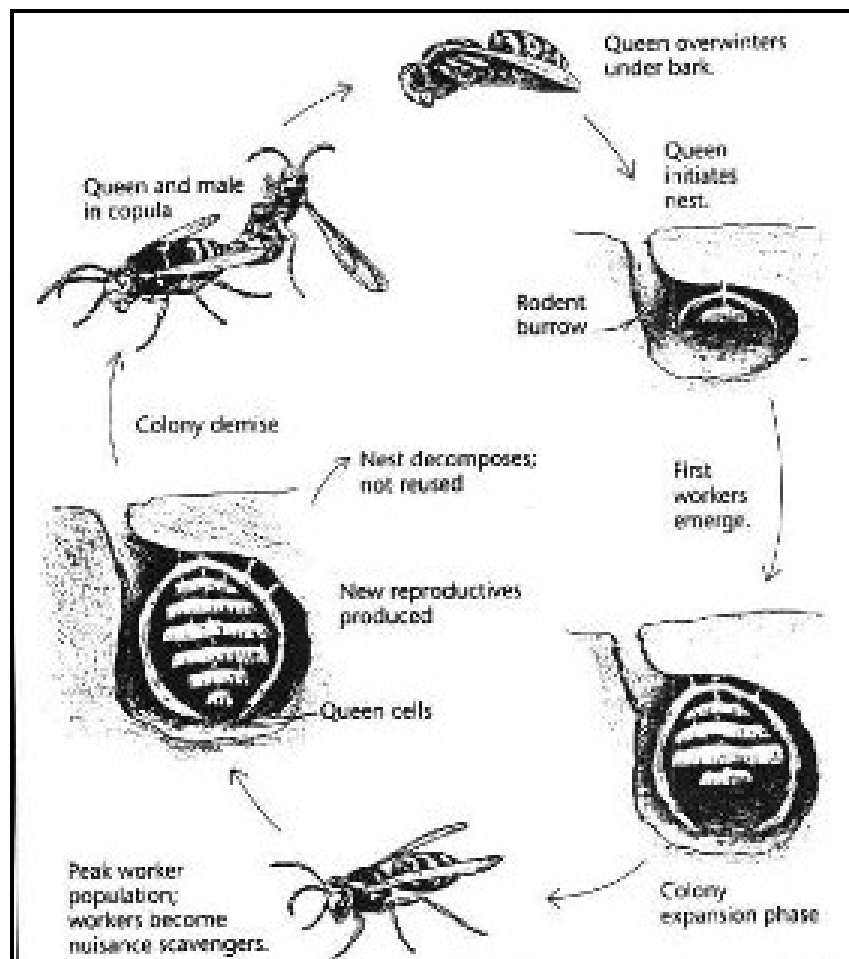
Late summer through late fall. The colony expands rapidly, reaching a maximum size of 4,000 to 5,000 workers and 10,000 to 15,000 brood cells in August and late September. At peak size, reproductive cells are built with new males and queens. Adult reproductives remain in the nest and are fed by the workers. New queens build up fat reserves to overwinter. Adult reproductives leave the parent colony to mate. After mating, males quickly die while fertilized queens seek protected places to overwinter.

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Winter. During early winter, the workers of the parent colony gradually leave the nest to die, as does the founding queen. Abandoned nests rapidly decompose and disintegrate during the winter. Nests inside structures however will persist as long as they are dry. **Nests are not used again.** In the spring, the cycle is repeated, although weather at this time will determine when colonies are established.

Why yellowjackets buzz around lemonade at Labor Day barbeques. Adult workers generally feed on foods rich in sugars and carbohydrates (fruits, flower nectar, and tree sap). The growing larvae, however, need protein. The workers, caretakers of the larvae, forage for insects, spiders, and meat, and then chew and condition these protein sources to feed to the larvae. Larvae in return secrete a sugary material relished by the adults. (This exchange of material is known as trophallaxis.) In late autumn, with no more larvae in the nest, workers forage primarily for ripe, decaying fruits and other sweets. By this time, there are thousands of workers who require a lot of sugary food, and are perceived by us as opportunistic scavengers.

Figure 3. Life Cycle of Ground-nesting Yellowjackets



Reprinted from Olkowski, W., S. Daar, and H. Olkowski. 1991. Common-sense Pest Control. Newtown, Conn. Taunton Press.

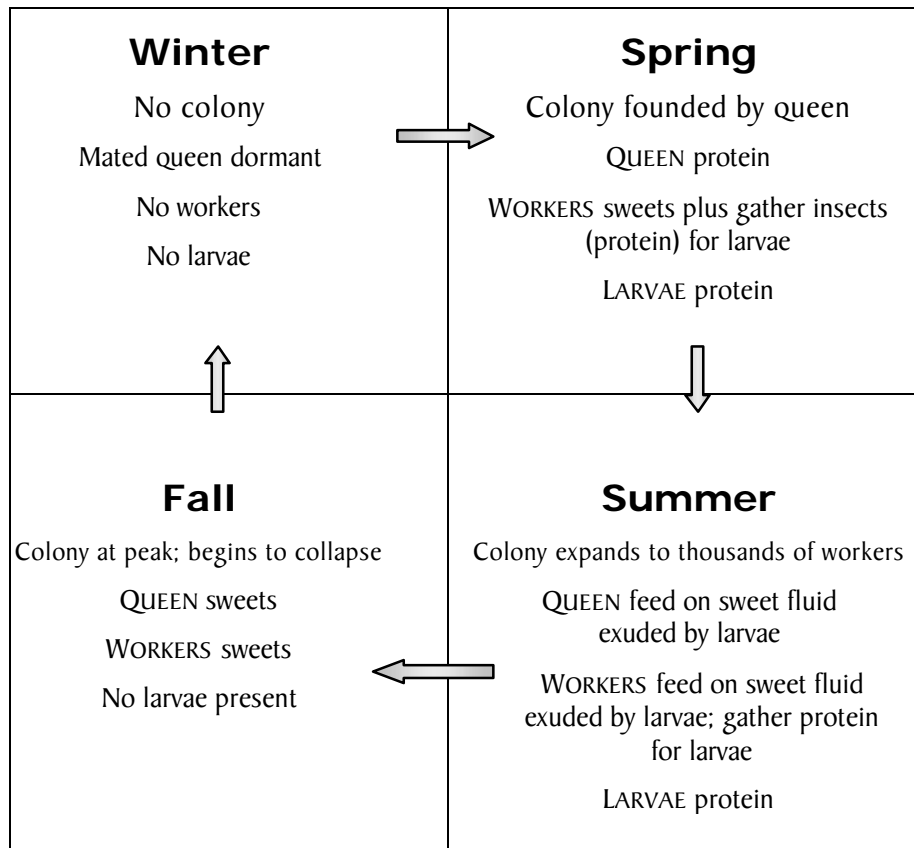
D. Food Preferences

Spring Queens forage for protein-containing food such as insects, spiders, or meat during the 30- to 45-day period before nests are built (Figure 4). Some of the food is eaten by the queens, but much of it is stockpiled for the first generation of worker larvae that hatch in the new nest. This protein-rich food sustains the growing larvae, and when they emerge as adult workers, they in turn forage for protein sources to feed the queen and second-generation worker larvae. The larvae secrete droplets of a sweet fluid from their mouthparts, which is ingested by the workers and queen. Foraging workers supplement their own diet with sweets, but primarily go after protein for the larvae. [Bait for queens and workers ➡ primarily protein]

Summer The colony expands to thousands of workers (plus the single queen), and workers continue to collect protein-rich food for the larvae. And the larvae continue to provide sweet fluid for the adult workers and queen. [Bait for workers ➡ primarily protein]

Fall As the larvae have all grown up, workers can no longer obtain sweet fluid within the nest. They and the newly produced males satisfy their craving for sweets by feeding on nectar, honeydew, fruit juices, sap, or other sweet substances. [Bait for workers ➡ primarily sweets]

Figure 4. Seasonal Food Preferences of Yellowjackets



E. IPM Program for Yellowjackets

Emphasize an IPM program based on monitoring and sanitation

Detection and monitoring

- ▶ Seasonal trapping strategies:
 - Spring and summer—Use traps with protein baits for monitoring and trapping.
 - Fall—Use sweets for trapping.
- ▶ For trapping, see below

Sanitation

- | | |
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| <ul style="list-style-type: none">▶ Use trash bags in all containers.▶ Use spring-closing garbage can tops.▶ Keep trash receptacles tightly closed and clean.▶ Tightly cover recycling bins and clean them daily. | <ul style="list-style-type: none">▶ Some districts have success using garbage bags impregnated with <i>d</i>-limonene to repel flies and yellowjackets. (Note: <i>d</i>-limonene, derived from citrus peel, is not exempt from notification and posting if used as a pesticide.) |
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Physical Control

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|--|--|
| <ul style="list-style-type: none">▶ Habitat modification—Seal holes and cracks in foundations, walls, roofs, and eaves.▶ Nest destruction—Call your area's mosquito abatement and vector control district. Service varies by area. Some will abate nests, others will only provide information. If you assist a professional, follow some basic safety precautions.▶ Locate any nests during the day and mark location.▶ Treat nests after yellowjackets are no longer active outside (dusk through night). | <ul style="list-style-type: none">▶ Wear a protective suit.▶ Stand back as far as is possible from the nest while treating. |
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Trapping

- | | |
|--|--|
| <ul style="list-style-type: none">▶ Place traps away from areas of activity.▶ Generally use protein-containing baits during late spring and early summer▶ Generally use sweet (commercial lure) baits during late summer through fall. | <ul style="list-style-type: none">▶ Recharge baits every three days (for lunchmeat or cat food) or every week (for commercial yellowjacket lures). |
|--|--|
- ▶ See *Trapping Tips* below; **Appendix 2**, Central Contra Costa Sanitary District, *Controlling Yellowjackets Around Your Home*; and **Appendix 4**, *Developing a Yellowjacket Trapping Program*

Chemical control

- | | |
|---|--|
| <ul style="list-style-type: none">▶ Least-toxic chemicals for treatment of nests:▶ Exempt from HSA-required notification and posting: mint oil▶ Not exempt from notification and posting: resmethrin, tetramethrin, or deltamethrin▶ See Appendix 3, Central Contra Costa Sanitary District, <i>Safe Use of Pesticides</i>) | <ul style="list-style-type: none">▶ Least-toxic chemicals for treatment of nests: As a last resort, use traps with protein baits and pesticide during spring and summer.▶ No pesticides for this purpose registered in California at printing, April 2004.) |
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Exercise

Trainer places yellowjacket traps at each location at least two hours before starting exercise.

Discuss the surrounding habitat and factors that may attract yellowjackets. See *Yellowjacket Monitoring Form* on the next page for possible discussion topics.

Divide class into teams of 2–3. Each team will have a clipboard and monitoring form and review instructions. Assign each team a trapping site (place where traps have been out for several hours) to evaluate. Have students check traps and count the number of yellowjackets in each trap. Compare trap catches. Students should evaluate the immediate vicinity for harborage and attractiveness using the monitoring form.

Facilitate discussion of the team summaries and results. Following trap evaluations, regroup and move entire class to each trapping site, allowing each team to summarize its evaluation and findings for the class.

Yellowjacket Monitoring Form

Use this form to keep track of yellowjacket activity from March through October. Monitor every 3–4 weeks. **Use the results to figure out where and when to place traps, and where to modify yellowjacket attractants such as overflowing garbage cans.**

Too many yellowjackets in the fall? Plan on monitoring to find out when queens first become active in the spring. During early spring, place traps around the periphery of the school. **Be careful not to locate traps in the midst of eating areas.** Although traps will catch a lot of the yellowjackets that frequent dining areas, you might unintentionally attract even more who will buzz around brown-bag lunches.

Date _____ Time _____

Weather Conditions _____

Monitoring Location _____

TRAP TYPE	<input type="checkbox"/> Sterling	<input type="checkbox"/> Yellowjacket Inn	<input type="checkbox"/> other(s):
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Yellowjackets:

other insects:

What's the source or likely area of the nest?			
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☐ dry field

☐ dry creekbed

☐ bare, eroding areas

☐ other(s):

What's attracting the yellowjackets?			
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☐ food

☐ trash can(s)

☐ drink

☐ recycling

☐ compost

☐ yellowjacket traps

☐ other(s)

Strategies to reduce yellowjacket presence?			
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☐ empty trash cans more often

☐ use covered cans

☐ wash recyclables

☐ other(s)

Note: Although depletion trapping is a good way to reduce the number of nest-founding queens, some people like to augment this practice with a toxicant. At the time of this writing, only experimental toxicants are available to researchers. Consult your county agricultural commissioner or vector control district for more information.

CONTROLLING

YELLOWJACKETS

AROUND YOUR HOME

With their potent sting, yellowjackets can be menacing creatures when it comes to a showdown over the picnic table. In years when the spring is warm and dry, yellowjacket populations can increase to the point of making outdoor activities difficult. But few people are aware that yellowjackets are voracious predators of insect pests such as caterpillars and flies.

IDENTIFICATION AND DETECTION

Yellowjackets are a type of wasp but they are often mistaken for bees. Sometimes they are confused with other less aggressive predatory wasps, especially paper wasps. Yellowjackets are relatively short and stout compared to paper wasps. Paper wasps have longer more slender bodies and long dangling legs. Yellowjacket nests are spherical and are enclosed in a papery envelope with a small entrance hole at the bottom. Paper wasp nests are usually suspended from eaves or porch ceilings and look like tiny umbrellas filled with hexagonal cells.

LESS-TOXIC CONTROLS

REMOVING AN INDIVIDUAL YELLOWJACKET FROM INSIDE THE HOUSE

If you are not hypersensitive to yellowjacket stings:

- don't aggravate the yellowjacket by swatting at it,
- wait until it lands on a flat surface,
- place a glass or plastic container over the insect,
- slide a stiff piece of paper under the opening of the container, and
- seal the container and place it in the freezer overnight to kill the yellowjacket or take it outside and release the insect.

If you are finding many yellowjackets inside, you may have a nest in a wall void.

DESTROYING NESTS

Because of the danger of multiple stings, we strongly recommend calling your local vector control district or a private company for information and assistance.

Yellowjackets build nests in abandoned rodent burrows and other holes in the ground, in attics, in wall voids, in shrubs and trees. Sometimes they hang their nests from eaves.

TRAPPING YELLOWJACKETS

Traps can provide temporary relief from yellowjackets, however individual yellowjackets can sometimes escape traps. There are a number of traps on the market, some disposable and others reusable. Experiment to find the trap or traps that work best for you.

- Follow label directions for setting traps, disposing of trapped yellowjackets, and cleaning and reusing traps that are reusable.
- Place a number of the traps around the periphery of your yard or picnic area to lure the yellowjackets away from your activities and food.
- Set the traps out a few hours before bringing food outdoors so the insects change their foraging patterns.
- If one of the traps is not attracting yellowjackets, move it. If you set out several traps and none of them are attracting yellowjackets even though they are present, try changing the bait. Use baits such as tuna-flavored cat food in the spring and early summer. Try using grenadine or the attractants that come with the traps in late summer and fall.

POISON BAITING

As a last resort in years when yellowjacket populations are extremely high, poison baiting may be necessary. Call a pest control professional.



Choose less toxic products for your home and garden. Look for this symbol before you buy.

PREVENTION

- Seal holes and cracks in foundations, walls, roofs, and eaves to prevent yellowjackets from entering your home.
- Cover attic and crawl space vents with fine mesh insect screen.
- Yellowjackets scavenge for meat and sweet foods and drinks in outdoor garbage and recycling bins. Clean recyclables before storing them. Keep garbage cans clean and tightly covered, or seal all food garbage in plastic bags.

WHY YELLOWJACKETS STING

Yellowjackets seldom sting when they are foraging for food, unless they feel threatened. They are, however, likely to attack when their nests are disturbed by a direct blow or by vibrations that are detected by the wasps inside. Mowing the lawn near an underground nest, construction work near a nest in a wall void, or even walking near a nest can provoke an attack by one or more yellowjackets. This is especially true if the nest has been disturbed before.

AVOIDING STINGS

When a yellowjacket approaches:

- Remain calm
- *Do not* strike at a yellowjacket with sharp, sudden blows. Slow, gentle motions that mimic the movement of a branch in the breeze will be safer in encouraging the yellowjacket to leave.

PRODUCTS

Examples of trade names for products listed in this fact sheet

Traps:

- Rescue! Yellowjacket (disposable)
- Rescue! Trap (reusable)
- Safer® Deluxe Yellowjacket/Wasp Trap
- Victor® Yellowjacket and Flying Insect Trap

- You can brush the yellowjacket off with a piece of paper or some other object as long as you move slowly and deliberately.
- Do not squash a yellowjacket. When crushed, many yellowjacket species emit a chemical that can cause other nearby yellowjackets to attack.

Yellowjackets can be a problem in May and June, but they are most noticeable and annoying late in the summer. During yellowjacket season, the following tips will help prevent stings.

- Wear protective clothing when mowing grass where you suspect underground nests.
- If you are hypersensitive to yellowjacket stings, avoid outdoor cooking or eating. Hypersensitive people should wear clothing that covers as much skin as possible, and carry an epinephrine kit (available by prescription) at all times.
- Outdoors, do not drink soft drinks or other sugary drinks from open containers. Use cups with lids and straws, and look before you sip. Do not carry snacks containing meat or sugar in open containers.
- Do not wear perfumes. Use unscented deodorant, sun screen, hair spray, etc.
- Avoid going barefoot, especially in vegetation.
- Always examine wet towels or wet clothing before you pick them up outdoors.
- Wear light-colored clothing without patterns.

PESTICIDES AND WATER POLLUTION

Common household pesticides show up in treated wastewater and in Bay Area creeks, sometimes at levels that can harm sensitive aquatic life. So, water pollution prevention agencies have teamed up with participating Bay Area stores to reduce the risks associated with pesticide use. This fact sheet is part of a series of information pieces and store displays aimed at educating Bay Area residents about less-toxic pest management. Look for the “Our Water Our World” logo next to products in participating hardware stores and nurseries throughout the Bay Area.

Pest control strategies and methods described in this publication are consistent with integrated pest management (IPM) concepts, and are based on scientific studies and tests in actual home and garden settings. Use suggested products according to label directions and dispose of unwanted or leftover pesticides at a household hazardous waste collection facility or event. No endorsement of specific brand name products is intended, nor is criticism implied of similar products that are not mentioned.

FOR MORE INFORMATION

For more information, contact:

Bio-Integral Resource Center (BIRC)
(510) 524-2567

University of California Cooperative Extension Master Gardeners in your area
(in the phone book)

Central Contra Costa Sanitary District
website: www.centralsan.org

University of California IPM website:
www.ipm.ucdavis.edu

ACKNOWLEDGMENTS

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UCCE Master Gardeners
Participating stores



SAFE USE AND DISPOSAL OF PESTICIDES

Commonly-used pesticides are getting into local creeks, the Bay, and the Delta. Testing has shown that even small amounts of these pesticides may be lethal to creatures that are an important part of the food web. Pesticides reach our waters through both the sewer and storm drain systems due to normal use and improper disposal. Other fact sheets in this series can help you prevent and effectively manage pest problems in your home and garden using the least toxic methods.

SELECT THE PROPER PESTICIDE

- Identify the pest and afflicted plant.
- Make sure the pesticide you choose is labeled for use on that plant and that pest.
- Read the entire label — it's the best source of information about how to use the product.
- If more than one product works, then select the least toxic pesticide. (see Signal Words, at bottom right).
- Buy only the amount you can use in one season.

- Time your treatments to catch pests at their most vulnerable stage.
- Spot treat whenever possible.
- Try to buy pesticides in single-use, or ready-to-use form. Avoid concentrates and the large economy size.

THE LABEL IS THE LAW

- The label on a pesticide container is a legal document that describes exactly how the product is to be used based on extensive testing. Make sure you understand how to mix and apply the pesticide before you begin, then follow all label directions exactly.
- Use the product only as described on the label.

SAFE USE AND STORAGE

- Read the label before using the pesticide and follow the directions. You can cause serious injury to yourself, children, pets and the environment if you misuse pesticides.
- Before using pesticides, remove children, pets, and toys from the area and cover birdbaths, fish ponds and anything else you don't want sprayed or dusted.
- Don't smoke, eat, chew gum or drink when handling pesticides.
- Follow label directions for wearing protective gear when mixing and

applying pesticides. Depending on the product, this might include: plastic or rubber **gloves**, **safety glasses or goggles**, a **respirator** rated for pesticides, **long-sleeved shirt**, **long pants or coveralls**, and **closed shoes** (no sandals or bare feet).

- If you buy concentrates and dilute them for use, mix up the smallest quantity that will do the job, and use it up.
- When mixing or measuring pesticides, use a dedicated set of spoons and cups. Mark the utensils with something permanent, such as fingernail polish, and store them with the pesticides so they won't ever be used in the kitchen.
- Store pesticides in their original containers, out of the reach of children

SIGNAL WORDS

Caution, **Warning**, **Danger** and **Poison** are "signal words" that indicate the product's level of acute toxicity to humans. *Caution* means slightly toxic, *Warning* means moderately toxic, *Danger* means highly toxic, and *Poison* indicates the greatest danger. In addition to the acute (immediate) risks, pesticides may also have chronic (long-term) risks to humans, animals, and the environment.



Choose less toxic products for your home and garden. Look for this symbol before you buy.

and pets, in a cool, dark, dry place outside the house. A locking cupboard in the garage or storage shed is ideal.

- Never remove labels or transfer pesticides to other containers.
- Water used to rinse out a sprayer or applicator should be applied like the pesticide.
- After applying pesticides, take a shower and put on clean clothes.
- Teach children that **pesticides are poisons** that shouldn't be touched or consumed.

PROPER DISPOSAL

If you find yourself with unwanted pesticides, give them to someone who can use them, or take them to a household hazardous waste collection facility or event like the ones listed below and **REMEMBER:**

- Don't pour leftover pesticides or water from rinsing equipment on the ground or in any type of drain inside or outside the house.
- Don't put pesticides in the trash.
- *Never* use or give away any pesticide that has been banned such as chlordane or DDT.

READING A PESTICIDE LABEL

PRECAUTIONARY STATEMENTS:

Known hazards to humans, domestic animals and the environment

NOTE TO PHYSICIANS:

Actions a doctor should take if the product is ingested, inhaled, or comes into contact with skin or eyes

FIRST AID INSTRUCTIONS:

Immediate action required if the product is ingested, inhaled, or comes into contact with skin or eyes

DIRECTIONS FOR USE:

How much product to use; how to mix and apply the product

CONTROLS:

Pests that the product is formulated to control

PLANTS:

Plants that can safely be treated with the product; if the product can be used on food plants, the label also tells you how many days before harvest you can apply the product

STORAGE AND

DISPOSAL:

How to safely store the product. Unwanted pesticides should be taken to a household hazardous waste facility or collection event

BRAND X PESTICIDE

ACTIVE INGREDIENTS:

The common name of the pesticide, and the chemical name if it has one; look here first to find out exactly what is in the product before buying it

SIGNAL WORD:

Caution, Warning, Danger, or Poison – signals the toxicity-level category of the product

PRODUCT CODE IDENTIFICATION:

The product code used by the manufacturer and the EPA; use this number when contacting the manufacturer or EPA about the product

PESTICIDES AND WATER POLLUTION

Water pollution prevention agencies have teamed up with Bay Area nurseries and hardware stores to reduce the risks associated with pesticide use. Common household pesticides show up in treated wastewater and in Bay Area creeks, sometimes at levels that can harm sensitive aquatic life. This fact sheet is part of a series of information pieces and store displays aimed at educating Bay Area residents about less-toxic pest management. Look for the **"Our Water Our World"** logo next to products in participating hardware stores and nurseries throughout the Bay Area.

Pest control strategies and methods described in these publications are consistent with integrated pest management (IPM) concepts, and are based on scientific studies and tests in actual home and garden settings. Use suggested products according to label directions and dispose of unwanted or leftover pesticides at a household hazardous waste collection facility or event. No endorsement of specific brand name products is intended, nor is criticism implied of similar products that are not mentioned.

FOR MORE INFORMATION

If you need additional information, contact:

Bio-Integral Resource Center (BIRC)
(510) 524-2567

University of California Cooperative Extension Master Gardeners in your area (in the phone book)

Central Contra Costa Sanitary District
website: www.centralsan.org

University of California IPM website:
www.ipm.ucdavis.edu

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Thank You:

UCCE Master Gardeners

Participating stores

FOR DISPOSAL OF HOUSEHOLD HAZARDOUS WASTE

If your community is not covered by any of the facilities or programs listed below, call your county environmental health department for information about the disposal of pesticides.

Alameda County	Household Hazardous Waste Program	510-670-6460
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Contra Costa County	Central Contra Costa Sanitary District	800-646-1431
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Central County	Contra Costa HHW Hotline	800-750-4096
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East and West County		
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Marin County	Household Hazardous Waste Hotline	415-892-7344
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Novato residents	Marin HHW Facility	415-485-6806
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Other areas	HHW Collection Facility	415-695-7375
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San Francisco	San Mateo Countywide HHW Hotline	650-363-4718
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San Mateo County		
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Santa Clara County	Monthly HHW Collection	650-496-6980
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Palo Alto		
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Solano County	HHW Programs	707-454-5705
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Vacaville	HHW Collection Facility	707-437-1111
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Fairfield, Suisun	Eco-Desk Hotline	707-527-DESK
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If you have any questions about the safety, environmental impact, or proper use of a pesticide, call the

National Pesticide Telecommunications Network 24-hour hotline at 800-858-PEST.



YELLOWJACKETS AND OTHER SOCIAL WASPS

Integrated Pest Management in and around the Home

Only a few of the very large number of wasp species in California live a social life; these species are referred to as social wasps. Some social wasps are predators for most or all of the year and provide a great benefit by killing large numbers of plant-feeding insects and nuisance flies; others are exclusively scavengers. Wasps become a problem only when they threaten to sting humans. One of the most troublesome of the social wasps is the yellowjacket. Yellowjackets, especially ground- and cavity-nesting ones such as the western yellowjacket (Fig. 1), tend to defend their nests vigorously when disturbed. Defensive behavior increases as the season progresses and colony populations become larger while food becomes scarcer. In fall, foraging yellowjackets are primarily scavengers and they start to show up at picnics, barbecues, around garbage cans, at dishes of dog or cat food placed outside, and where ripe or over-ripe fruit are accessible. At certain times and places, the number of scavenger wasps can be quite large.

IDENTIFICATION AND LIFE CYCLE

In western states there are two distinct types of social wasps: yellowjackets and paper wasps. Yellowjackets are by far the most troublesome group. Paper wasps are much less defensive and rarely sting humans. They tend to shy away from human activity except when their nests are located near doors, windows, or other high traffic areas.

Nests of both yellowjacket and paper wasps typically are begun in spring by

a single queen who overwinters and becomes active when the weather warms. She emerges in late winter/early spring to feed and start a new nest. From spring to midsummer nests are in the growth phase, and the larvae require large amounts of protein. Workers forage mainly for protein at this time (usually in the form of other insects) and for some sugars. By late summer, however, the colonies grow more slowly or cease growth and require large amounts of sugar to maintain the queen and workers. So foraging wasps are particularly interested in sweet things at this time.

Normally, yellowjacket and paper wasp colonies only live one season. In very mild winters or in coastal California south of San Francisco, however, some yellowjacket colonies survive for several years and become quite large.

Yellowjackets

The term yellowjacket refers to a number of different species of wasps in the genera *Vespula* and *Dolichovespula* (family Vespidae). Included in this group of ground-nesting species are the western yellowjacket, *Vespula pensylvanica*, which is the most commonly encountered species and is sometimes called the "meat bee," and seven other species of *Vespula*. *Vespula vulgaris* is common in rotted tree stumps at higher elevations and *V. germanica* (the German yellowjacket) is becoming more common in many urban areas of California, where it frequently nests in houses. These wasps tend to be medium sized and black with jagged bands of bright yellow (or white in the case of the aerial-nesting



Figure 1. Western yellowjacket.

Dolichovespula [= *Vespula*] *maculata*) on the abdomen, and have a very short, narrow waist (the area where the thorax attaches to the abdomen).

Nests are commonly built in rodent burrows, but other protected cavities, like voids in walls and ceilings of houses, sometimes are selected as nesting sites. Colonies, which are begun each spring by a single reproductive female, can reach populations of between 1,500 and 15,000 individuals, depending on the species. The wasps build a nest of paper made from fibers scraped from wood mixed with saliva. It is built as multiple tiers of vertical cells, similar to nests of paper wasps, but enclosed by a paper envelope around the outside that usually contains a single entrance hole (Fig. 2). If the rodent hole is not spacious enough, yellowjackets will increase the size by moistening the soil and digging. Similar behavior inside a house



Figure 2. Yellowjacket nest in spring (top), summer (center), and early fall (bottom).

sometimes leads to a wet patch that develops into a hole in a wall or ceiling.

Immature yellowjackets are white, grublike larvae that become white pupae. The pupae develop adult coloring just before they emerge as adult wasps. Immatures are not normally seen unless the nest is torn open or a sudden loss of adult caretakers leads to an exodus of starving larvae.

Aerial-nesting yellowjackets, *Dolichovespula arenaria* and *D. maculata*, build paper nests that are attached to the eaves of a building or are hanging from the limb of a tree. The entrance is normally a hole at the bottom of the nest. These aerial nesters do not become scavengers at the end of the season, but they are extremely defensive when their nests are disturbed. Defending *D. arenaria* sometimes bite and/or sting, simultaneously. Wasp stingers have no barbs and can be used repeatedly, especially when the wasp gets inside

clothing. As with any stinging incident, it is best to leave the area of the nest site as quickly as possible if wasps start stinging.

Paper Wasps

Paper wasps such as *Polistes fuscatus*, *P. aurifer*, *P. apachus*, and *P. dominulus* are large (1 inch long), slender wasps with long legs and a distinct, slender waist (Fig. 3). Background colors vary, but most western species tend to be golden brown, or darker, with large patches of yellow or red. Preferring to live in or near orchards or vineyards, they hang their paper nests in protected areas, such as under eaves, in attics, or under tree branches or vines. Each nest hangs like an open umbrella from a pedicel (stalk) and has open cells that can be seen from beneath the nest (Fig. 4). White, legless, grublike larvae sometimes can be seen from below. Paper wasp nests rarely exceed the size of an outstretched hand and populations vary between 15 to 200 individuals. Most species are relatively unaggressive, but they can be a problem when they nest over doorways or in other areas of human activity, such as fruit trees.

Mud Daubers

Mud daubers are black and yellow, thread-waisted, solitary wasps that build a hard mud nest, usually on ceilings and walls, attended by a single female wasp. They belong to the family Sphecidae and are not social wasps but may be confused with them. They do not defend their nests and rarely sting. During winter, you can safely remove the nests without spraying.

INJURY OR DAMAGE

Concern about yellowjackets is based on their persistent, pugnacious behavior around food sources and their aggressive colony defense. Stinging behavior is usually encountered at nesting sites, but scavenging yellowjackets sometimes will sting if someone tries to swat them away from a potential food source. When scavenging at picnics or other outdoor meals,

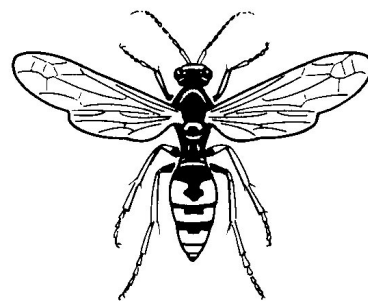


Figure 3. Paper wasp.

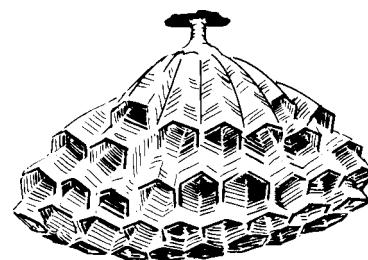


Figure 4. Paper wasp nest.

wasps will crawl into soda cans and cause stings on the lips, or inside the mouth or throat.

Responses to wasp stings vary from only short-term, intense sensations to substantial swelling and tenderness, some itching, or life-threatening allergic responses. All these reactions are discussed in detail in *Pest Notes: Bee and Wasp Stings* (see "References"). Of specific concern is a condition that results from multiple-sting encounters, sometimes unfamiliar to attending health professionals, that is induced by the volume of foreign protein injected and the tissue damage caused by destructive enzymes in wasp venom. Red blood cells and other tissues in the body become damaged; tissue debris and other breakdown products are carried to the kidneys, to be eliminated from the body. Too much debris and waste products can cause blockages in the kidneys, resulting in renal insuffi-

ciency or renal failure. Patients in this condition require medical intervention, even dialysis.

MANAGEMENT

Most social wasps provide an extremely beneficial service by eliminating large numbers of other pest insects through predation and should be protected and encouraged to nest in areas of little human or animal activity. Although many animals prey on social wasps (including birds, reptiles, amphibians, skunks, bears, raccoons, spiders, preying mantids, and bald-faced hornets), none provides satisfactory biological control in home situations.

The best way to prevent unpleasant encounters with social wasps is to avoid them. If you know where they are, try not to go near their nesting places. Wasps can become very defensive when their nest is disturbed. Be on the lookout for nests when outdoors. Wasps that are flying directly in and out of a single location are probably flying to and from their nest.

Scavenging wasps will not usually become a problem if there is no food around to attract them. When nuisance wasps are present in the outdoor environment, keep foods (including pet food) and drinks covered or inside the house and keep garbage in tightly sealed garbage cans. Once food is discovered by wasps, they will continue to hunt around that location long after the source has been removed.

If wasp nests must be eliminated, it is easiest and safest to call for professional help. In some areas of California, personnel from a local Mosquito and Vector Control District may be available to remove nests. To determine if this service is available in your area, call the California Mosquito and Vector Control Association at (916) 440-0826.

If a rapid solution to a severe yellowjacket problem is essential, seek the assistance of a professional pest control operator who can use microencapsulated baits to control these pests. Do-

it-yourself options include trapping wasps in a baited trap designed for that purpose, early-season removal of nests, or spraying the nest or nesting site with an insecticide labeled for that use.

Trapping Wasps

Trapping wasps is an ongoing effort that needs to be initiated in spring and continued into summer and fall, especially when the yellowjacket population was large the previous year. In spring there is a 30- to 45-day period when new queens first emerge before they build nests. Trapping queens during this period has the potential to provide an overall reduction in the yellowjacket population for the season, and a study is currently underway to test this theory in some California Mosquito and Vector Control districts (see "Online References"). The more traps put out in spring on an area-wide basis to trap queens, the greater the likelihood of reducing nests later in the summer. Usually one trap per acre is adequate in spring for depletion trapping of queens; in fall, more traps may be necessary to trap scavenging wasps, depending on the size of the population. There are two types of wasp traps: lure and water traps.

Lure Traps. Lure traps are available for purchase at many retail stores that sell pest control supplies and are easiest to use. They work best as queen traps in late winter and spring. In summer and fall they may assist in reducing localized foraging workers, but they do not eliminate large populations. Lure traps contain a chemical that attracts yellowjackets into the traps, but common lures such as heptyl butyrate are not equally attractive to all species. Proteins such as lunchmeat can be added as an attractant and are believed to improve catches.

During spring, baited lure traps should have the chemical bait changed every 6 to 8 weeks. In summer, change the bait every 2 to 4 weeks; change bait more frequently when temperatures are high. Meats must be replaced more

frequently because yellowjackets are not attracted to rotting meat. Also, periodically check the trap to remove trapped yellowjackets and make sure workers are still attracted to the trap.

Water Traps. Water traps are generally homemade and consist of a 5-gallon bucket, string, and protein bait (turkey ham, fish, or liver works well; do not use cat food because it may repel the yellowjackets after a few days). The bucket is filled with soapy water and the protein bait is suspended 1 to 2 inches above the water. (The use of a wide mesh screen over the bucket will help prevent other animals from reaching and consuming the bait.) After the yellowjacket removes the protein, it flies down and becomes trapped in the water and drowns. Like the lure trap, these traps also work best as queen traps in late winter to early spring. In summer and fall they may assist in reducing localized foraging workers but usually not to acceptable levels. Place them away from patio or picnic areas so wasps aren't attracted to your food as well.

Discouraging or Eliminating Nests

Early in the season, knocking down newly started paper wasp nests will simply cause the founding female to go elsewhere to start again or to join a neighboring nest as a worker. As there is little activity around wasp nests when they are first starting, they are very hard to find. Wasps are more likely to be noticed later after nests and populations grow. Nest removal for controlling subterranean or cavity-dwelling yellowjackets is not practical because the nests are underground or otherwise inaccessible.

Nest Sprays

Aerosol formulations of insecticides on the market labeled for use on wasp and hornet nests can be effective against both yellowjackets and paper wasps, but they must be used with extreme caution. Wasps will attack applicators when sensing a poison applied to their nests, and even the freeze-type prod-

ucts are not guaranteed to stop all wasps that come flying out. It is prudent to wear protective clothing that covers the whole body, including gloves and a veil over the face. In addition, you need to wear protective eyewear and other clothing to protect yourself from pesticide hazards. Wasps are most likely to be in the nest at night. But even after dark and using formulations that shoot an insecticide stream up to 20 feet, stinging incidents are likely. Underground nests can be quite a distance from the visible entrance and the spray may not get back far enough to hit the wasps. Partially

intoxicated, agitated wasps are likely to be encountered at some distance from the nest entrance, even on the day following an insecticidal treatment. Hiring a pest control professional will reduce risks to you and your family; in some areas of California, this service may be available through your local Mosquito and Vector Control District.

REFERENCES

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Ebeling, W. 1975. *Urban Entomology*. Oakland: Univ. Calif. Agric. Nat. Sci.

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Online References

California Mosquito and Vector Control Web site (www.sac-yolomvcd.com) for information on yellowjacket control

For more information contact the University of California Cooperative Extension or agricultural commissioner's office in your county. See your phone book for addresses and phone numbers.

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To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash nor pour pesticides down sink or toilet. Either use the pesticide according to the label or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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Developing a Yellowjacket Trapping Program

Trapping Yellowjackets Without Using Pesticides—Start Early

You don't necessarily need pesticides to kill yellowjackets—they'll fly into purchased **lure traps** and starve to death (see photo at right), or dive into homemade **water traps** and drown. Both traps are effective if routinely maintained. You can use either lure or water traps to catch queens in the early spring. **There's a 30- to 45-day window in early spring when queens forage for food while they're establishing nests. Each queen trapped at this time represents one less nest of 500 to 5,000 workers in the summer and fall.** Keep in mind that trapping workers during summer is not as efficient as trapping queens in spring, but you may still reduce the total number of yellowjackets in an area by the time late summer comes. Make sure you locate traps away from areas where people gather.



Using a Lure Trap to Eliminate Queens (Depletion Trapping)

Most lure traps come with a packet of heptyl butyrate, a yellowjacket attractant, that you open when you set out the trap. Directions accompanying the trap will suggest whether to use sugar or protein food bait (or skip food bait altogether), depending on the season. Some traps will also provide a food bait, which also helps attract yellowjackets. If you use a protein bait such as lunchmeat, replace it every day or two, or the traps will smell putrid and repel yellowjackets. Whenever you clean out the traps—removing rotting meat or dead yellowjackets—do so between dusk and dawn when yellowjackets are inactive. When you notice trap catches diminishing you may have to recharge traps with more heptyl butyrate, which you can purchase at some hardware stores.

Constructing a Yellowjacket Water Trap

These do-it-yourself traps attract queens as well as workers. Bait is suspended over soapy water. As yellowjackets swoop over the water, they'll seize scraps of the bait, fly downward as the bait weighs them down, and unintentionally plunge into the water.

- Fill a 5-gallon bucket with about six inches of water. Add 5–6 drops of liquid dish soap. Adding soap to the water reduces the surface tension, causing the yellowjackets to sink and drown.
- Place a stick across the top of the bucket and suspend protein bait such as lunchmeat or liverwurst by a string from the center of the stick about 1 to 2 inches above the water.
- Place wide-mesh screen over the top of the bucket to allow yellowjackets entry while keeping larger animals away from the bait.
- Locate the trap away from gathering or eating areas, and out of reach of pets or small children.
- Be sure to change the bait before it rots, every day or two, and spill out foul water and drowned yellowjackets.

Portions reprinted courtesy UC IPM Pest Note 7450, *Yellowjackets and Other Social Wasps*,
<http://www.ipm.ucdavis.edu/PDF/PESTNOTES/pnyellowjackets.pdf>